Suggested Citation: Gran, K. B., Behar, H., Burgeson, E., Dymond, S., Dumke, J., & Teasley , R. (2021). Data for Impacts of beaver dams on low-flow hydrology and hydraulics, Knife River, Minnesota [Data set]. Data Repository for the University of Minnesota (DRUM). https://doi.org/10.13020/W16T-NA37

Metadata for Impacts of beaver dams on low-flow hydrology and hydraulics, Knife River, Minnesota

Author Information:
Principle Investigator and Lead Contact:
Karen Gran
Department of Earth & Environmental Sciences
University of Minnesota Duluth
1114 Kirby Drive
Duluth, MN 55812
218-726-7406
kgran@d.umn.edu
ORCID: 0000-0001-9832-3016

Co-Investigators:
Salli Dymond
Department of Earth & Environmental Sciences
University of Minnesota Duluth
ORCID: 0000-0001-7160-7705

Rebecca Teasley
Department of Civil Engineering
University of Minnesota Duluth
ORCID: 0000-0003-3845-9995

Josh Dumke
Natural Resources Research Institute
University of Minnesota Duluth
ORCID: 0000-0003-0555-1568

Primary Data Collectors:
Hannah Behar, Emma Burgeson
Department of Earth & Environmental Sciences
University of Minnesota Duluth

Funding source:
This work was prepared by Gran et al. using federal funds under award NA18OAR4170101 from Minnesota Sea Grant, National Sea Grant College Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of NOAA, the Sea Grant College Program, or the U.S. Department of Commerce.

Overview of Data Collected:
These data were collected as part of a two-year investigation into the impacts of beaver dam removal on low-flow hydrology and hydraulics in the Knife River, Minnesota, USA. Eight sub-basins were monitored for two years, organized as four pairs of sub-basins. The study focused on small headwater sub-basins, with areas ranging from 1.58 to 6.4 km^2. In 2018, all of the study basins had active beaver dams. In 2019, the beavers were removed and dams notched in half of the sub-basins, one half of each of the four pairs.

Sensors to record pressure and temperature were installed within beaver impoundments, downstream of beaver impoundments in the stream and in shallow groundwater wells within the floodplain, and in the air. Additional in-stream measurements of velocity and depth were collected along cross-sections in order to measure discharge and develop rating curves at each sampling site. Lastly, water samples were collected at all sites to measure stable isotopes of oxygen and hydrogen. Details of sample collection and analysis can be found in Behar (2020) and Burgeson (2021).

A more focused study occurred at two sites (2B and 4B) in July-August 2019. Additional temperature sensors were installed downstream of beaver impoundments in the streambed. A weather station was installed at site 2B to record air temperature, relative humidity, solar radiation, and wind speed. A rhodamine tracer test was run at each site with dye released into the subsurface in the beaver impoundment with samples collected downstream. One tracer test was run at site 2B on 7/27-7/28/19, and one tracer test was run at site 4B on 7/23-7/24/19. For further information, please consult Behar (2020).

Details on Data Files:
The data files are organized by data type, with similar files collected together in the same .zip file. Each data source is described below.

Air_Temperature_2018.zip

One Hobo Water Temp Pro v2, model U22-001 (Onset Corp., Borne, MA) temperature sensor was installed in each sub-basin, attached to a shaded tree branch and further shaded with a PVC shield. Air temperature was recorded every 15 minutes. At site 2T, a Hobo 30-foot Depth Water Level logger, model U20-01-001, was installed to record both air temperature and barometric pressure. Both data sets can be found in the 2T file listed below. The table below shows the site locations and dates of data collection. The air temperature data here were QA/QC'd to remove times spent in transit to and from the site.

Site	Latitude	Longitude	Start Date	End Date	File name
1T	47.15194	-91.7541	5/22/18	10/18/18	Air Temperature (1T, 2018)
2B	47.01002	-91.8819	5/23/18	10/7/18	Air Temperature (2B, 2018)
3B	46.99559	-91.787	5/23/18	10/12/18	Air Temperature (3B, 2018)
4B	46.96421	-91.8211	5/29/18	10/16/18	Air Temperature (4B, 2018)
4T	46.9725	-91.8172	6/12/18	10/16/18	Air Temperature (4T, 2018)
2T	46.9966	-91.8737	5/18/18	10/12/18	Air Temperature and Pressure (2T, 2018)

Air_Temperature_2019.zip

One Hobo Water Temp Pro v2, model U22-001 (Onset Corp., Borne, MA) temperature sensor was installed in each sub-basin, attached to a shaded tree branch and further shaded with a PVC shield. Air temperature was recorded every 15 minutes. At site 2T, a Hobo 30-foot Depth Water Level logger, model U20-01-001, was installed to record both air temperature and barometric pressure. Both data sets can be found in the 2T file listed below. The table below shows the site locations and dates of data collection.

Site	Latitude	Longitude	Start Date	End Date	File name
1B	47.14261	-91.7716	5/17/19	11/03/19	Air Temperature (1B, 2019)
1T	47.15194	-91.7541	5/17/19	11/03/19	Air Temperature (1T, 2019)
2B	47.01002	-91.8819	5/15/19	11/01/19	Air Temperature (2B, 2019)
3B	46.99559	-91.787	5/18/19	11/04/19	Air Temperature (3B, 2019)
4B	46.96421	-91.8211	5/21/19	11/03/19	Air Temperature (4B, 2019)
4T	46.9725	-91.8172	5/28/19	10/11/19	Air Temperature (4T, 2019)
2T	46.9966	-91.8737	5/14/19	12/21/19	Air Temperature and Pressure (2T, 2019)

Coordinates.zip

There are two files in this zip archive that contain the location information for all of our data collection sites. The first file (*Pond_Stream_Air_Locations.csv*) gives the coordinates for all of the data sensor locations for the main monitoring project. The codes used are defined below.

Air temp (xx-air temp)	Temperature sensor installed in air
Pond temp (xx-pond temp)	Temperature sensor installed in pond
Stream temp (xx-temp) #	Temperature sensor installed in stream; # refers to location with respect to the beaver impoundment. 1 is closest to impoundment and 3 is farther downstream
Evap pan (xx-evap pan)	Shallow pan installed to measure evaporation
Stream gauge (xx-stream)	Location of pressure transducer installed in stream
US Well (xx-uswell)	Location of pressure transducer installed in shallow well near the pond (only labelled upstream when two wells were installed in the same watershed)

US Temp (xx-us temp)	Location of temperature sensor placed in the channel upstream of the dam (2019 only).
Well (xx-well)	Location of pressure transducer installed in shallow well

xx refers to the site location (1B, 1T, 2B, 2T, 3B, 3T, 4B, or 4T)

Streambed_Montoring_Locations.csv gives the locations of additional sensors installed in summer 2019 to monitor the temperature conditions in the streambed in and around beaver impoundments at sites 2B and 4B. Additional information about site locations can be found in Behar (2020).

Discharge.zip

Pressure transducers installed at stream gauge locations (Hobo 30-foot Depth Water Level logger, model U20-01-001 (Onset Corp., Norner, MA) recorded water pressure every 15 minutes. These were transformed into water depths by using the HOBOware barometric compensation assistant coupled with the closest air pressure transducer. In addition, manual measurements of water level were taken on days when discharge measurements were made. Rating curves were developed for each site each year. Cross-sectional measurements of depth and velocity are archived in Cross_Sections.zip (within the Discharge.zip file). Rating curves were used in conjunction with barometrically-compensated water level data to generate 15m discharge data (in Stream_Depth_Discharge.zip) for each site. Details of rating curve development and associated uncertainties are given in Burgeson (2021). Daily average discharge data in m3/s are given for each site in DailyAverageDischarge_2018.csv and DailyAverageDischarge_2019.csv. These files also include the daily average discharge from the mainstem Knife River gage (USGS gage 04015330).

Isotopes.zip

Water samples were collected at all sampling sites throughout the two years of study and analyzed using a Picarro L2130-i Isotope and gas Concentration Analyzer (Picarro Inc., Santa Clara, CA, USA) at the University of Minnesota Duluth. Additional information on sample collection and analysis protocols can be found in Burgeson (2021). Sample data from 2018 are found in Isotopes_all_info_2018.csv, and sample data from 2019 are found in Isotopes_all_info_2019.csv.

Soils_2018_2019.zip

Soil samples were collected at all of the sites when shallow wells were installed. Textural analyses using a standard hydrometer method for all of these samples were conducted to get sand, silt and clay fractions. These data can be found in Soil_Texture_main.csv. The other files include data specifically located in the two intense study sites (2B and 4B) studied by Behar (2020). Data include bulk density of samples collected in the stream bed, and soil textures (sand, sily, clay fractions) for streambed samples at sites 2B and 4B. Analysis methods for all of the samples are described in more detail in Behar (2020).

Streambed_Temperature_2019.zip

These files record streambed temperatures on a series of thermal arrays installed within the bed of beaver impoundments at sites 2B and 4B and in the streambed in locations downstream from the beaver impoundments. The temperature data are in degrees C and were collected every 15 minutes using Thermochron iButtons, model DS1921H F5# (OnSolution Pty Ltd., NSW, Australia). The sensors were affixed to a post and driven into the subsurface to depths of 5, 15, and 25cm below the bed. Additional details on methodology can be found in Behar (2020).

Tracer_Test_data_2019.zip

Tracer tests were run in summer 2019 at sites 2B and 4B. Rhodamine WT was injected into a shallow well (30 cm depp) located in the pond behind beaver impoundments at sites 2B and 4B. One tracer test was run at site 2B on 7/27-7/28/19, and one tracer test was run at site 4B on 7/23-7/24/19. The results from a Seapoint Rhodamine Fluorometer are given in each file, one per site. For further information, please consult Behar (2020).

Water_Temperature_2018.zip
Water_Temperature_2019.zip
Water_and_Air_Temperature_2018.zip
Water_and_Air_Temperature_2019.zip

The two Water_Temperature files contain .csv files with water temperature data collected every 15 minutes at sites across the watershed in 2018 and 2019. The temperature data were collected with Hobo Water Temp Pro v2, model U22-001 (Onset Corp., Borne, MA). The two files labeled Water_and_Air_Temperature contain the same water temperature data matched with the air temperature data collected from a single air temperature sensor installed in each sub-basin. For the well temperature data In 2018, both the 1B and 1T sites are paired with the air temperature sensor from 1B in 2018 as there are no sensor data from 1T. In 2018 and 2019, the 3B and 3T sites both used the air temperature sensor installed in 3B as there were no sensor data from 3T. Both years also contain pond water temperature data, and the data from 2019 also contain sensors placed upstream of beaver impoundments (not present in 2018).

Two of the water temperature data were flagged as problematic in 2019: 1T-3 had temperatures that appear too high at the end of the season and 4B-3 had temperatures that were overly damped starting in mid-summer. Those datasets should be avoided or used with caution.

Weather_2B_Tripod_2019.zip

The data files in this archive contain data from a weather station installed at site 2B near station 2B-DS-1. The weather station was placed in an area with no overhanging tree cover. Solar radiation (Silicon Pyranometer Smart Sensor, model S-LIB-M003, (Onset Corp., Borne, MA)), air temperature and relative humidity (12-bit Temperature/Relative Humidity Smart Sensor, model S-THB-M002, (Onset Corp., Borne, MA)), and wind speed (Wind Speed Smart Sensor, model S-WSB-M003 (Onset Corp., Borne, MA)) were recorded every 15 minutes from 6/21/19 - 10/30/19. Additional information about data collection can be found in Behar (2020).

Well_levels.zip

Shallow wells were installed in the floodplain in all of the sub-basins. In some sub-basins, two wells were installed. All site locations can be found in *Coordinates.zip*. Within each shallow PVC well, a Hobo 30-foot depth water level logger, model U20-01-001 (Onset Corp., Brne, MA)

were installed. These pressure transducers recorded temperature and pressure. Pressure data were converted into well level data (meters above sensor) by using the Hoboware Pro barometric compensation assistant. The pressure sensor installed in the air at site 2T was used for all barometric pressure compensation measurements. Because wells were pumped periodically to collect water samples for isotope analyses, well levels were interpolated between the time pumping started and the point at which the level recharged to close to the initial height.

References Cited:

Behar, H. Modeling stream thermal dynamics: The influence of beaver dams in a Minnesota watershed. [M.S. Thesis]. Duluth, MN: University of Minnesota Duluth; 2020, https://hdl.handle.net/11299/216777.

Burgeson, E. Beaver dam impacts on low flow hydrology in the Knife River watershed. [M.S. Thesis]. Duluth, MN: University of Minnesota Duluth; 2021, in prep.